

Managing Lymphedema, Increasing Range of Motion, and Quality of Life through Yoga Therapy among Breast Cancer Survivors: A Systematic Review

Abstract

Lymphedema is a common complication of breast cancer treatment. Yoga is a nonconventional and noninvasive intervention that is reported to show beneficial effects in patients with breast cancer-related lymphedema (BCRL). This study attempted to systematically review the effect of yoga therapy on managing lymphedema, increasing the range of motion (ROM), and quality of life (QOL) among breast cancer survivors. The review search included studies from electronic bibliographic databases, namely Medline (PubMed), Embase, and Google Scholar till June 2019. Studies which assessed the outcome variables such as QOL and management of lymphedema or related physical symptoms as effect of yoga intervention were considered for review. Two authors individually reviewed, selected according to Cochrane guidelines, and extracted the articles using Covidence software. Screening process of this review resulted in a total of seven studies. The different styles of yoga employed in the studies were Iyengar yoga (n = 2), Satyananda yoga (n = 2), Hatha yoga (n = 2), and Ashtanga yoga (n = 1). The length of intervention and post intervention analysis ranged from 8 weeks to 12 months. Four studies included home practice sessions. QOL, ROM, and musculoskeletal symptoms showed improvement in all the studies. Yoga could be a safe and feasible exercise intervention for BCRL patients. Evidence generated from these studies was of moderate strength. Further long-term clinical trials with large sample size are essential for the development and standardization of yoga intervention guidelines for BCRL patients.

Keywords: *Arm function, arm volume, breast cancer survivors, grip strength, secondary arm lymphedema, symptom management*

Introduction

The most commonly diagnosed cancer in women worldwide is breast cancer, accounting for 21%.^[1] Although breast cancer treatments such as surgery, radiotherapy, chemotherapy, and hormonal therapy have improved patient outcomes, these techniques cause patients to potentially suffer substantial adverse effects.^[2] One of the chief complications due to treatments is lymphedema which is a chronic health problem. Breast cancer-related lymphedema (BCRL) comprises of a set of pathological conditions, in which protein-rich fluid accumulates in soft tissues because of lymphatic flow interruption.^[3] BCRL is an agglomeration of symptoms such as swelling of arm, decreased physical functioning and body motion, altered sensation in limbs, and fatigue accompanied by psychological stress.^[4] Individual health

factors of patients such as obesity or higher body mass index can increase the risk of lymphedema while infections or trauma can trigger BCRL.^[5-7]

Axillary dissection and radiation therapy have been known to increase the risk of BCRL.^[8] Treatment of lymphedema associated with breast cancer can include combined modality approaches, compression therapy, therapeutic exercises, and pharmacotherapy. Complete decongestive therapy is a multimodality approach and is considered the “gold standard” for lymphedema treatment. The therapy includes various techniques, such as manual lymphatic drainage, external compression garments and bandages, skin care, and exercises guided by specially trained therapists.^[9,10] It has been considered safe for BCRL patients to indulge in progressive exercise.^[10] Different types

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of exercises including aqua training, yoga, resistance, and aerobic exercises have been employed in mitigating BCRL symptoms,^[11] of which yoga has been a familiar intervention showing gradual betterment of patients.^[12]

Yoga has shown positive results on treatment-related outcomes such as pain, fatigue, depression, mood, and quality of life (QOL).^[13] However, the sustainability of pain relief after yoga-based intervention needs more investigation. Targeted yoga intervention programs have been proven to improve the overall sleep quality, reduced daytime functioning,^[14] fatigue-related symptoms,^[15] blood cortisol levels,^[16] postchemotherapy-induced nausea and vomiting,^[17] lowered musculoskeletal problems such as muscle soreness and overall physical discomfort,^[18] and reduced psychological-related symptoms such as anxiety and depression.^[19] Despite a number of reports and reviews supporting efficacy of yoga in health care, the awareness and integration of yoga in conventional health care remain limited.^[20] There are limited guidelines available for utilising yoga as treatment protocols for health conditions based on clinical or practice-based evidence.^[21] Yoga has proven to be effective in reducing BCRL symptoms and as a lifestyle management therapy by research studies. Specific postures and breathing can help in better draining of the lymphatic fluid.^[22] However, the studies have not followed any standard recommendation for managing lymphedema symptoms through yoga therapy.

Therefore, the main purpose of this review is to synthesis evidence regarding the beneficial effects of yoga intervention in lowering the BCRL symptoms and improving the QOL in breast cancer survivors.

Methods

The current systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and the minimum standards prototype given by the Cochrane Collaboration for reporting items. The primary outcomes of this study were the improvement in lymphedema symptoms, range of motion (ROM), and QOL of breast cancer patients with lymphedema.

Literature search

The search strategy was developed for each database based on the PICO format [Table 1]. Three databases namely PubMed (Medline), Embase, and Google Scholar were searched for articles till July 2020. References of included publications and review articles were cross-referenced to retrieve any additional relevant citations.

Inclusion criteria

The studies that assessed the outcome variables such as lymphedema-related symptoms, ROM, and QOL were included. Survival period was not a criterion for selection and all the breast cancer survivors who received any

form of yoga intervention to manage lymphedema were selected. Irrespective of age group, type of yoga, duration, and setting of exercise intervention, studies were included if the main criteria was met. Studies were excluded if symptoms other than lymphedema were the primary focus. Only original and review articles published in English which were observational or interventional in nature with quantitative data were included in the review. The search was not limited to any time period.

Selection process

The studies retrieved by searching the databases were imported into the Covidence software which is a commonly used program to organize systematic research works provided by the Cochrane Collaboration.^[23] The titles and abstracts of all studies were screened for relevance independently by two authors (VS, SL) to determine the eligibility. The articles were chosen if both authors agreed. In case of discrepancy, a consensus was arrived after discussion. The full text of the selected articles was then screened for eligibility by the two authors independently. In case of discrepancy, agreement was reached after deliberation.

Extraction of data

After the completion of full text screening, data from the included studies were manually extracted by the authors (VS, SL) in a template created exclusively for extracting data which included all the traits of the studies, in accordance with the Cochrane protocol. Data on disciplines such as method of the study, participant characteristics, nature of intervention, outcomes, and results were extracted and maintained from which relevant fields were tabulated.

Quality assessment of included studies

The risk of bias of included studies was evaluated by the two authors (VS, SL) independently using the National Institute of Health (NIH) guidelines for assessing the quality. Aspects of research question, study design, participants, statistical analyses, and study outcomes were scrutinized based on the twelve questions given by the NIH guidelines.^[24] Based on the tool, each component of a study was given one point with a total score of 12. The scores of both the investigators were averaged to attain the absolute score for each study which determined the quality as “high,” “medium,” and “low.” Discrepancies were rechecked with a third author (KN) and consensus was achieved by discussion.

Results

Selection of studies

A PRISMA diagram summarizing selection of studies is presented in Figure 1. The literature search identified 409 citations (79 from Medline, 268 from Embase, and 62 from Google Scholar), of which 201 studies were identified as

Table 1: Search strategy

PICO elements	Databases used		Indexed search terms (emtree)	Search strategy	PubMed Indexed Search terms	Free-text words	Search strategy	Free-text words	Google Scholar Free-text words	Search Strategy
	Embase	Indexed search terms (emtree)								
P (Patient or Population)	[Breast cancer] exp	[Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer]	[Breast cancer] exp OR Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer	[Breast cancer] exp OR Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer	Breast cancer [MeSH]	Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer	Breast cancer [MeSH] OR Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer	Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer	Breast cancer OR Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer	Breast cancer OR Breast carcinoma OR Breast gland neoplasm OR Mammary cancer OR Mammary gland cancer
Boolean I (Intervention)	[Yoga] exp	Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	[Yoga] exp OR Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	[Yoga] exp OR Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	Yoga [MeSH]	Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	Yoga [MeSH] OR Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	Yoga OR Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	Yoga OR Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath	Yoga OR Hath OR Iyengar OR Asanas OR Breathing exercise OR Iyengar's hath
Boolean C (Comparison)/ Determinants	[Lymphedema] exp	Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	[Lymphedema] exp OR Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	[Lymphedema] exp OR Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	Lymphedema [MeSH]	Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	Lymphedema [MeSH] OR Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	Lymphedema OR Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema	Lymphedema OR Lymphoedema OR Lymphatic edema OR Lymph static edema OR Lymphatic oedema
Boolean O (Outcome)	[Health status OR Quality of life OR Arm volume] exp	Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	[Health status OR Quality of life OR Arm volume] exp OR Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	[Health status OR Quality of life OR Arm volume] exp OR Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	Health status OR Quality of life OR Arm volume [MeSH]	Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	Health status OR Quality of life OR Arm volume [MeSH] OR Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	Health status OR Quality of life OR Arm volume OR Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	Health status OR Quality of life OR Arm volume OR Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep	Health status OR Quality of life OR Arm volume OR Physical wellbeing OR Wellbeing OR Psychological function OR Physical function OR Functional ability OR Fatigue OR Pain OR Sleep

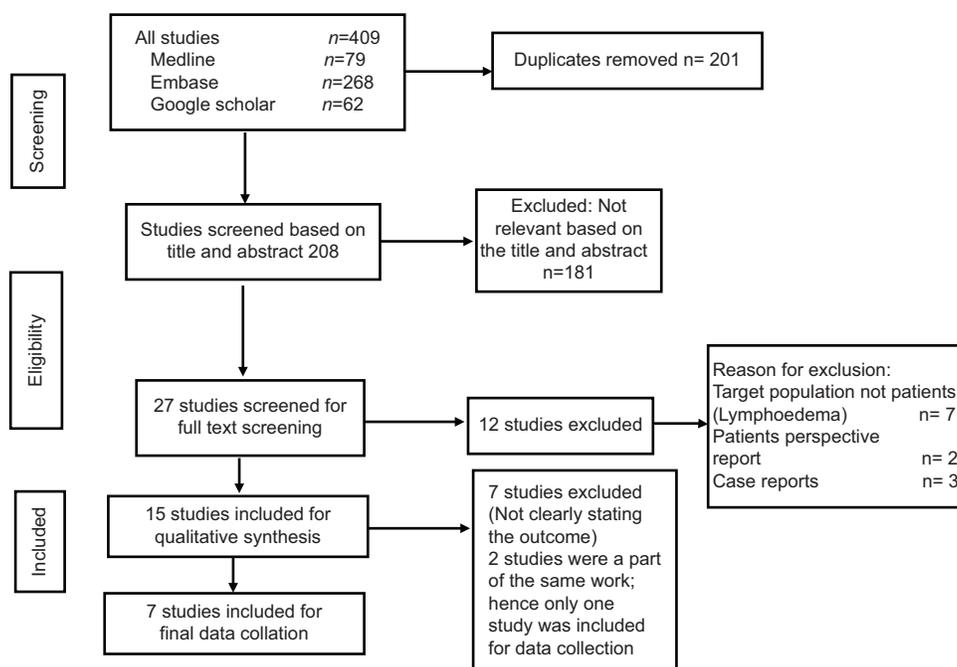


Figure 1: Search results and study selection

duplicated and exempted. This resulted in 208 studies, out of which 181 studies were excluded based on the relevance after reviewing the title and abstract yielding 27 studies. Finally, eight publications from seven studies were included. Cross-referencing yielded no additional results.

Risk of bias in individual studies

The risk of bias assessed by NIH quality assessment tool is summarized in Table 2. Five studies had moderate quality,^[20,25-28] one study found to have good quality^[29] and one study was in low quality.^[30]

Summary of included studies

The summary of selected studies is presented in Table 3. Studies yielded were from 2011 to 2020. Out of seven studies, three studies were conducted in USA, two studies in Australia, one study in Poland, and one in Ukraine all of which were from developed countries and none from developing regions. Three studies were randomized controlled trials,^[28-30] three were single group pre-posttest,^[20,26,27] one study was controlled clinical trial,^[25] and four studies were conducted at pilot level.

Six studies were conducted in the urban setting and one study in the suburban setting, but none of the included studies were from the rural.

Study characteristics

The characteristics of studies and study population are presented in Table 4. The studies were conducted in women above 18 years of age with the mean age of participants being above 50 years and the mean or median age ranging from 52 to 65 years. The sample size ranged from 6 to

30.^[26-30] One study was conducted in postmenopausal women^[26] and one study included participants who were at high risk for BCRL.^[27]

Randomization of participants was not mentioned in studies excepting three studies which used randomized controlled trial,^[28-30] out of which one study mentioned blinding the assessors who evaluated the outcome.^[29] Convenience sampling was followed in three studies^[20,25,26] where the patients were referred or volunteered to be a part of the study. Sample size estimation was done in two studies.^[28,29]

Participants currently undergoing treatment and with metastatic or recurrent cancer was a common exclusion criteria in studies.^[20,26,27] Preexisting BCRL condition was an exclusion criterion in the study by Mazor *et al.*^[27] Long-term investigation of the effects of yoga was conducted after 3 months,^[29] 6 months,^[28,30] and 12 months in three studies.

Volumeter, handheld grip dynamometer, goniometer, perometer, and tissue tonometry were some of the tools used for recording arm measurements. Three studies used Functional Assessment of Cancer Therapy-Breast,^[20,26,28] one used QOL-Breast 23 (QLQ-BR23),^[25] and one used visual analog scale (VAS)^[30] to assess the QOL.

Cancer treatment

Treatments recorded in the studies were surgery, radiation, chemotherapy, hormone therapy, immunotherapy, or a combination of treatment methods. The surgeries included lymph node dissection, breast conserving surgery, modified radical mastectomy, and total or partial mastectomy. Two studies did not report the details of the treatment

Table 2: Assessment of risk of bias according to National Institute of Health guidelines

Author name (years)	Study population clearly mentioned	Eligibility/ selection criteria for the study population and clearly described	Participants in the study of all eligible participants or clinical interest	Enrollment of all participants	Sufficiently large sample size in the findings	Confidence in the findings	Service/ intervention clearly described and consistently across the study population	Outcome measures prespecified, valid, reliable, and assessed consistently across all study participants	Blinding of outcome assessors 20% or less were accounted for in the analysis	The loss to follow-up after baseline were accounted for in the pre-to-post changes	Outcome measures of interest taken multiple times before and after the intervention	Intervention was conducted at a group level (e.g., a whole hospital, a community, etc.)	Quality
Andysz A et al., (2014)	●	●	●	●	●	●	●	●	●	●	●	●	Moderate
Fisher MI et al., (2014)	●	●	●	●	●	●	●	●	●	●	●	●	Moderate
Galantino ML et al., (2012)	●	●	●	●	●	●	●	●	●	●	●	●	Moderate
Mazor, M et al., (2018)	●	●	●	●	●	●	●	●	●	●	●	●	Moderate
Loudon A et al., (2016)	●	●	●	●	●	●	●	●	●	●	●	●	Good
Douglass J et al., (2012)	●	●	●	●	●	●	●	●	●	●	●	●	Low
Odynets T et al., (2019)	●	●	●	●	●	●	●	●	●	●	●	●	Moderate

● Yes
 ● No
 ● Not reported

Table 3: Summary of the included studies

Description	Categories	n (n=7)
Place of study	North America	3
	Australia	2
	Europe	1
	Ukraine	1
Settings	Rural	0
	Urban	6
	Suburban	1
Gender	Male	0
	Female	7
Sample size	<10	1
	10–20	3
	Above 20	3
Year of publication	1991–1995	0
	1996–2000	0
	2001–2005	0
	2006–2010	0
	2011–2015	4
	2016–2018	2
	2019–2020	1
Study type	Single-group pretest–post-test design	3
	Randomized control pilot study	2
	Experimental study with control group	1
	Randomized prospective control trial	0
Age group	<18 years	0
	More than 18 years and older	7
Frequency of yoga session	1 session/week	2
	2 session/week	2
	3 session/week	2
	1 session/week with daily home practice	1
Duration of yoga session	60 min	2
	90 min	4
	1 h	1
Length of yoga intervention	8 weeks	4
	10 weeks	1
	4 weeks	1
	12 months	1
Styles of yoga	Hatha	2
	Iyengar	2
	Ashtanga	1
Modification of yoga styles	Satyananda	2
	Yes	7
Outcome*	Quality of life	5
	Arm function	1
	Arm volume	3
	Lymphedema status	3
	Grip strength	2
	Functional ability	3
	Pain	2
	Muscle strength	1
	Spinal mobility	1
	Fatigue	1
	Tissue induration	1
	Degree of sensation	1

*Total does not add to 8 as more than one method used in a study

received by the participants.^[20,26] One study included the survivors at risk (sentinel lymph node dissection, ALND, or axillary XRT) for lymphedema^[27] and three studies included survivors with BCRL. One study did not report the status of lymphedema, however studied the arm-related symptoms.^[25] Comorbidities such as hypertension, type 2 diabetes, and injuries in the affected area were reported in one study.^[30] Four studies mentioned the use of compression sleeves,^[20,26,29,30] while there was no mention in three studies.^[25,27,28]

Yoga interventions

The details of yoga interventions offered by the studies are summarized in Appendix 1. Two studies used Iyengar yoga,^[20,25] Satyananda yoga,^[29,30] and Hatha yoga^[26,28] each while Ashtanga yoga^[27] was followed in one study. The attributes of the yoga intervention were diverse in the studies. The duration of intervention ranged from 4 to 12 months. Number of yoga sessions ranged from 8 to 144 and the duration of each session ranged from 40 to 90 min. The poses were modified based on the patient's ability in all studies. The interventions were led by trained and certified yoga therapists in all seven studies. All studies have given a detailed account of the postures and breathing techniques used for intervention except two study.^[28,30] The sessions were conducted at the center in all studies and in addition four studies had home practice as part of the intervention. In all the studies with home practice, participants were provided either with instruction manual^[27,30] or DVD.^[26,29] The adherence to the practice was assessed based on the practice log in two studies.^[26,29] One study recorded the practice log but did not report practice adherence.^[26] Other studies did not report practice adherence although home practice was a component of the intervention.^[27,30]

Outcome measures

The detailed analysis of tools used and the outcome variables of the studies are presented in Table 5. QOL was assessed in five studies using standardized tools.^[20,25,26,28,30] Pain^[20,25,30] and ROM^[27,29] were assessed in three and two studies respectively. Spinal mobility was evaluated in one study to investigate improvements in the entire upper body movements.^[29]

Arm measurements

Grip strength evaluated in one study reported significant improvement in within limb group (mean difference [MD] [95% confidence interval (CI)]: 3.56 [1.15, 5.97], $P < 0.01$), in the experimental group^[27] and one study reported significant difference between the control and the intervention group (MD [95%CI]: 3.58 [1.50, 5.67], $P = 0.01$)^[29] whereas one study did not show any difference in hand grip strength ($P = 0.26$).^[26] One study showed a significant decrease in arm volume owing to yoga exercise ($P = 0.02$)^[26] while two studies showed statistically insignificant decrease (% reduction:

Table 4: Characteristics of the included studies

Author, years	Country	Study design	Age (x [SD])/ (M [MR])	n	Population	Yoga type	Session type	Duration (weeks)	Total number of sessions	Weekly sessions/ duration (min)	Practice setting
Andysz et al., (2014)	Poland	CCT	E: 54.8 (7.4) C: 58.6 (10.8)	28 E-12 C-16	Survivors	Iyengar's hatha yoga	One-one (individualized)	10	10	1/90	Center
Fisher et al., (2014)	USA	Pilot study – study design not mentioned	E: 55.1 (2.5), C: 60.5 (3.6)	6	Survivors with lymphedema	Hatha yoga	NM	8	24	3 Centre-60 Home-45	Center, Home
Galantino et al., (2012)	USA	SG P and P test-pilot study	M: 58 (MR: 50–71)	10	Postmenopausal women-after 1 month posttreatment	Iyengar yoga	Group	8	16	2/90	Center
Mazor et al., (2018)	USA	SG P and P test-pilot study	52 (9.1)	17	Survivors Mean survival 25.9 months	Ashtanga yoga	NM	8	16	2/60	Center, home
Loudon et al., (2016)	Australia	RCT-pilot study	E- 55.1±2.5 C- 60.5±3.6	23 E-12 C-11	Within 6 months posttherapy	Satyananda yoga	NM	8	8	1/90	Center home
Douglass et al., (2012)	Australia	RCT	65 (12.4)	18	Survivors with lymphedema	Satyananda yoga	Group	4	28	1/centre 90 6/home -40	Center, home
Odynets et al., (2019)	Ukraine	Randomized prospective control trial	59.10 (1.37)	30	Survivors	Hatha	Group	12 months	144	3/60	Centre

N=Number, x (SD)=Mean (standard deviation), M (MR)=Median (median range), E=Experimental group, C=Control group, NM=Not mentioned, SG P and P=Single group pre and post, RCT=Randomized Control Trial

Table 5: Outcome variables, tools used and effect of yoga intervention on outcome variables of different studies

Author, years	Surgery type	Lymph-oedema	Outcome assessed	Tools used	Findings	Quality
Andysz et al., (2014)	BCS±lymph node dissection MRM±lymph node dissection (survivors)	NR	QOL	QLQ-C30, QLQ-BR23	QOL↑Arm symptoms↓	Moderate
Fisher et al., (2014)	Not mentioned (survivors who had lymphedema)	+	QOL Arm function, arm volume	FACT-B (QOL), DASH, volumeter, Jamar hand held grip dynamometer	Arm volume↓QOL# Arm function# Hand grip strength#	Moderate
Galantino et al., (2012)	Not mentioned (survivors who were postmenopausal and currently using aromatase inhibitor)	Studied but NR	Balance and flexibility, QOL, pain, physical activity	FRSR, FACT-B, BPI, PSFS	Balance and flexibility↑QOL↑Pain↓Physical activity↑	Moderate
Mazor et al., (2018)	Surgery±chemo and radiation (survivors who were at high risk for BCRL)	Patients with risk for lymphedema	Limb volume, arm strength, ROM	Flexible nonstretch tape, MicroFet dynamometer, goniometer	Upper extreme volume# ROM↑Shoulder flexion↑External rotation↑Shoulder abduction↑Grip strength↑Elbow flexion↑	Moderate
Loudon et al., (2016)	Surgery±lumpectomy, mastectomy, chemo, radiation (survivors with unilateral secondary lymphedema stage one)	+	ROM, muscle strength, grip strength and Spinal mobility	Two-armed goniometer, handheld dynamometer, hand-held grip dynamometer spinal mobility - video analysis software	Lumbo-pelvic posture↑Pelvic obliquity↓Strength in shoulder abduction↑ROM#	Good
Douglass et al., (2012)	TM, PM, XRT of the axilla, aromatase therapy (survivors with BCRL)	+	SRL symptoms, arm volume, QOL, pain	SRL symptoms, BIS, perometry, and tissue tonometry, visual analog scale	Lymphedema symptoms# Limb size# QOL↓Pain↓	Low
Odynets et al., (2019)	Madden mastectomy	+	QOL	FACT-B	QOL↑	Moderate

↑=Increased, ↓=Decreased, #=No difference, +=Lymphedema present. BCS=Breast conserving surgery, MRM=Modified radical mastectomy, TM=Total mastectomy, PM=Partial mastectomy, BCRL=Breast cancer-related lymphedema, NR=Not reported, NP=Not present, QOL=Quality of life, ROM=Range of motion, SRL=Symptoms=Self-reported lymphedema symptoms, QL-C30=Quality of life cancer care 30, QLQ-BR23=Quality of life-Breast 23, FACT B=Functional assessment of cancer therapy- breast, DASH=Disabilities of the arm, shoulder, and hand, FR SR=The functional reach and sit and reach, quality of life, PSFS=Patient specific functional scale, BPI=Brief pain inventory, UE=Upper extremity, BIS=Bioimpedance spectroscopy

14.3, $P = 0.98$)^[30] (MD [95% CI]: 21.68 [-75.45, 32.09]).^[27] Douglass *et al.* also studied other parameters of BCRL in detail all of which showed insignificant results including perometry for arm volume (% reduction: 9.8, $P = 0.91$), tonometry of the upper arm ($P = 0.80$), heaviness ($P = 0.86$), tightness ($P = 0.93$), burning sensation ($P = 0.85$), temperature ($P = 0.90$), and pins and needles ($P = 0.64$). Galantino *et al.* studied the arm function as the reach, regular household activities which uses arm and showed significant improvement.^[20]

Range of motion

ROM of the shoulder was studied in detail by Loudon *et al.* and reported insignificant reduction in both control and intervention groups with significant improvement in internal rotation of the affected arm in the intervention group (MD [95% CI]: -10.97 [-17.37, -4.56], $P = 0.001$). The study also evaluated the spinal ROM reported significant improvement in the angle of pelvic obliquity (MD [95% CI]: -9.96 [-14.54, -5.37], $P = 0.001$) but found no significant difference between groups after intervention.^[29] Mazor *et al.* reported significant improvement in certain components of ROM such as elbow flexion (MD [95% CI]: 2.70 [1.19, 4.22]), shoulder external rotation (MD [95% CI]: 4.65 [1.70, 7.59]), shoulder flexion (MD [95% CI]: 4.50 [1.59, 7.41]), and shoulder abduction (MD [95% CI]: 2.44 [0.58, 4.29], $P < 0.05$).^[27]

Pain

Pain was investigated in two studies before and after yoga intervention. One study did not find significant difference in pain between the group continued and discontinued yoga ($P = 0.90$).^[30] Other study showed significant reduction in brief pain inventory (BPI) pain severity ($P = 0.016$) but insignificant reduction in BPI pain interference ($P = 0.07$).^[20] One study evaluated pain, swelling, and sensitivity collectively as arm symptoms and found significant decrease ($P = 0.046$).^[25]

Quality of life

QOL increased in studies by Andysz *et al.* (increase in mean within intervention group from 58.3 to 75, $P = 0.048$ and significant difference between intervention group (mean: 17.6) and control group (mean: 11.1), $P = 0.03$);^[25] Galantino *et al.* (increase in mean from 89.33 to 106.05, $P < 0.05$);^[20] Odynets *et al.* (increase in mean from 82.80 to 120.9; $P < 0.01$)^[28] while no difference between groups was observed in study by Fisher *et al.* ($P = 0.12$).^[26] Although it decreased in one study^[30] in both the groups, the decline of QOL score was more in the group that discontinued yoga practice (14.3%) than in group which continued yoga (3.6%). No adverse effects were reported in any of the studies as a result of yoga intervention. Two studies which accounted adverse effects unrelated to the intervention.^[27,29] Yoga was reported as a safe tool by three studies.^[20,25,27]

Discussion

In this systematic review, the effect of yoga therapy on ROM, lymphedema symptoms, and QOL among breast cancer survivors with lymphedema has been evaluated. The consistency was found among the results of yoga having a positive effect on BCRL patients in all studies, although one study could not achieve statistical significance.^[30]

In the current systematic review, sample size was not sufficiently large and was reported as a limitation in all studies and four studies were conducted at pilot levels. Although Loudon *et al.* calculated the sample size *a priori*, the study could not achieve the estimated sample size.^[29] Some studies could not record significant changes in the outcome such as QOL, arm function, hand grip strength, lymphedema symptoms, and limb size after the yoga interventions owing to small sample size, measurement errors, or the comorbidity conditions as stated by the studies.^[26,30] However, individual attention was possible among the BCRL patients because of the small sample size. The current review also agrees with a recent systematic review conducted among BCRL patients that there was no uniformity in the duration, type, and intensity among the selected studies.^[31]

There were variations in the studies with respect to the usage of compression sleeves in the yoga intervention groups. Early intervention using compression sleeves and its long-term usage have shown to improve the symptoms in BCRL patients.^[32,33] Whether or not the participants consistently wore the compression sleeve was not mentioned in any of the studies in this review. Thus, manipulation of this extrinsic variable specific to BCRL condition should not be overlooked as it could affect the consistency of results considerably. It has been found that breast cancer survivors with lymphedema were more in need of psychological counseling than those without, which is a direct implication on the QOL of BCRL patients.^[34] The studies in this review used specific QOL tools except one study which used VAS^[30] to assess QOL. On the contrary, a review study by Fu *et al.* identified the use of overall HRQOL tool in most studies than the disease-specific QOL tool.^[35]

The precision of breathing or meditative techniques and the focus on postures may differ during supervision and at home practice in naive practitioners. In studies with home practice sessions, supply of reference material (instruction manual or DVD) to the participants becomes important to improve their adherence in future.^[21] Practicing using video aid is much easier and less laborious than practicing from illustrated aids. Practice adherence among BCRL patients was discussed by two studies in this review.^[26,29] Adherence plays a vital role in bringing out the desired health outcomes,^[36] which in the case of BCRL condition is better arm symptoms and improvements in daily activities increasing the QOL. Factors such as age and gender have

not been found to be significantly associated with adherence of yoga practice; however, mood, social support, perceived health benefits, and motivation have been associated with adherence in behavioral interventions.^[36] Douglass *et al.*^[30] and Loudan *et al.*^[29] stated orienting the participants at the beginning of the study about management of symptoms, self-care, and importance of exercise. This may also influence the adherence as it is essential to convince participants to incorporate yoga into their daily routine. These two were the only studies in this review to also conduct a long-term research. It could be inferred from this review that longitudinal researches on the effect of yoga on BCRL patients are limited. Further long-term studies are necessary to understand the compliance, reminiscence of the learned techniques, and quality of self-practice.

Yoga as intervention for health conditions has often been implicated as postures combined with breathing techniques,^[37] which is also observed from the studies in this review. In yoga intervention, not merely the accuracy of techniques, but the subjective experience of the individual is also important. The studies have not mentioned the rationale (e.g. practice of asanas coordinated with breathing is more comfortable to train the movements in arms and chest than doing a posture focusing on form) or specific goals (e.g. strengthening, flexibility, improving ROM or calmness) of exercises which it aims to achieve during the course of intervention. Such knowledge will help in better comprehension in the participants and reflect in their attitude and practice.

From the studies included in this review, it could be inferred that yoga intervention session of 60 min daily for a minimum of 8 weeks could produce beneficial effects in BCRL symptoms. The conclusion of clinical practice obtained from this study is similar to a recent review conducted on yoga intervention among BCRL patients.^[31] Owing to its diversity and complexity of the multiple dimensions, it is challenging to determine the combination of components of yoga to bring about the desired health benefit.^[37] Loudan *et al.* published guidelines for yoga intervention in BCRL patients but this is based on Satyananda yoga.^[38] As the various styles of yoga concentrate on different aspects, guidelines for health conditions should be developed individually for specific styles of yoga.^[21] Further detailed research is necessary to conceive evidence-based guidelines for BCRL condition.

Conclusion

Evidence of moderate robustness was generated from these studies to affirm the safety and efficacy of yoga intervention in managing lymphedema of breast cancer survivors. QOL and survival improved in the patients even with a short duration of the intervention demonstrating its usefulness in coping lymphedema. Only one standard guideline with specifications for duration, frequency, and intensity targeting BCRL is available for till date. Large

sample-sized trials should be conducted to investigate practice adherence and to synthesize robust evidence to incorporate yoga into routine clinical practice.

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Conflicts of interest

There are no conflicts of interest.

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Appendix 1 : Details of yoga intervention used in studies

Yoga type	Intervention summary	Components of intervention
<p>Iyengar's Hatha Yoga^[25]</p> <p>Adjusted based on participants needs module prepared by, certified yoga instructor</p> <p>Props used: Bolsters, wooden blocks, straps</p>	<p>Modified for participants' needs using props such as bolsters, wooden blocks and straps. Practice consisted of standing, seated and lying postures followed by Pranayama (Ujjayi/Viloma - seated or lying and relaxation (Savasana)</p>	<p>Asanas/poses (Modifications)</p> <p>(1)Supta Badha Konasana (supine) (2) Adho Mukha Virasana (prone, seated forward bend)</p> <p>Standing postures: (3) Tadasana with supported back (4) Vrksasana (5) Trikonasana (6-7) Virabhadrasana I and II.</p> <p>Seated postures: (8) Bharadvajasana with a hand supported on the wall or a block, (9) Janu Sirsasana with the use of strap, (10) twist in Upavista Konasana (11) Upavista Konasana with the use of a strap.</p> <p>Lying & inversion (12) & 13) Supta Padangusthasana I and II, (14) Viparita Karani with hips supported on a bolster and legs supported on the wall.</p> <p>Pranayama (15) Ujjayi or Viloma breath (Sitting/lying)</p> <p>Relaxation (16) Savasana</p>
<p>Hatha yoga^[26]</p> <p>Certified yoga instructor, with training in yoga for cancer patients</p> <p>2 sessions instructor lead, 1 session video recorded</p> <p>Prop used; table top</p>	<p>Practice consisted of centering with seated breathing, warm up exercises, standing postures, seated postures, lying postures, supported inversion (viparitakarani) and lying relaxation (Savasana)</p>	<p>Warm up and centering: Ujjayi breath in seated position, neck stretches and rolls, shoulder shrugs and rolls, isometric shoulder blade squeeze, isometric chest press, shoulder circles, wrist stretches, fists clenched, gentle backbend, seated forward fold with legs crossed, seated spinal twist, cat/cow pose, spinal balance half spinal balance (half spinal balance), downward facing dog pose (table top)</p> <p>Standing: Warrior I flow (bend and straighten arms and legs in a flow) (hands at heart center or hips), exalted warrior (reaching arm up instead of reaching back into the backbend), warrior II (hands at heart center or on hips), triangle pose (use a block or bend extended leg if the hamstrings are tight), tree pose (may come to the wall and place a hand on wall if balance is unsteady, intensity adjusted by walking toes out to the center of the room or by adjusting the placement of extended arm at the wall)</p> <p>Seated: Forward fold (use a strap wrapped around the balls of the feet or bend the knees), seated spinal twist with bottom leg extended, bound angle with hands interlaced behind the back (if shoulders are tight, can grab for wrist instead, or hold the feet) cow face with arms (use a strap for tight shoulders)</p> <p>Lying: Pigeon pose (lie on back and place one ankle on top of the opposite thigh in "number 4 pose". Then either interlace hands behind thigh or shin and draw legs in toward the chest), Child's pose (legs wide a part with big toes touching)</p> <p>Finishing: Pelvic tilts on back, Bridge pose (Block under the sacrum for support), Crunches (Feet can stay on the floor), stretch out long on mat - full body, knees to chest with side - side roll, supine twist (can keep knees together instead of crossing knee over opposite thigh), legs-up-the-wall (bolster or blanket under hips for support and extra height) savasana (bolster under the knees to protect low back)</p>
<p>Iyengar yoga^[20]</p> <p>Certified and trained yoga instructor (500 hours of training completed and registered with yoga alliance)</p>	<p>Practice consisted of seated pranayama, upper extremity and lower extremity focus, spine focus including standing, seated and lying postures followed by Savasana. Home practice options (15–30 min) consisted of modified lower back and upper back movements, pranayama, meditation and Savasana</p>	<p>Upper-extremity focus</p> <p>(1) 10 min organizational issues/introduction</p> <p>(2) 10 min seated nadi shodana and focusing</p> <p>(3) 10 min upper-back movements – setu bhadasana</p> <p>(4) Child's pose extended, breath into upper back</p> <p>(5) Gentle twists/arm binds</p> <p>Standing</p> <p>(6) Focusing on opening upper back, chest, and arms</p> <p>(i) Tadasana</p> <p>(ii) Virabhadrasana I (arms up variation)</p> <p>(iii) Trikonasana (arms wide variation)</p> <p>(iv) Adhomuka savasana (knees bent)</p> <p>(v) Padottasana (arms behind back)</p> <p>(vi) Ardha uttanasana (half-way up)</p>

Contd...

Appendix 1 : Contd...

Yoga type	Intervention summary	Components of intervention
		Seated
		(7) Focus on upper back, chest, and extremities
		(i) Navasana (supported)
		(ii) Dandasana
		(iii) Janu sirsasana/pascimottanasana
		(iv) Wrist work
		Supine twist
		(8) (thoracic focus)
		Relaxation
		(9) Savasana
		Lower-extremity focus
		1. 10 min organizational issues/introduction
		2. 10 min seated nadi shodana and focusing
		3. 10 min lower-back movements—setu bandhasana
		4. Child's pose toes underextended, breath into lower back
		Standing
		5. Focusing on opening lower back and hips
		(i) Tadasana to ardha chandrasana (supported)
		(ii) Virabhadrasana I (arms up variation)
		(iii) Ajaneasana (knee down lunge), (iv) Lunges with knee at wall on blocks
		(v) Adhomuka savasana (against wall or straightening legs)
		(vi) Padottasana (arms under shoulders/twists)
		(vii) Garudasana (chair balance variations – no arms)
		(viii) Bhekasana
		6. Focus on lower back and hips
		(i) Bhujangasana (supported variations)
		(ii) Baddha konasana/Janu sirsasana (forward extension)
		(iii) Ankle and foot rolls
		7. Supported backbends with blocks
		8. Supine twist (lumbar focus)
		9. Savasana
		Spine focus
		(1) 10 min organizational issues/introduction
		(2) 10 min seated nadi shodana and focusing
		(3) 10 min hip and back movements – setu bhadrasana
		(4) Sukasana with twists and side extensions
		(5) Child's pose side to side
		(6) Cat/cow
		(7) Adhomuka svanasana – bent knees
		Standing
		(8)
		(i) Tadasana to ardha chandrasana (supported)
		(ii) Trikonasana I
		(iii) Parsvakonasana
		(iv) Padottasana (with extended twists)
		Seated
		(i) Dandasana
		(ii) Pascimottanasana
		(iii) Prasarita Padattonasana (with side extensions)
		10. Supported backbend series on block
		11. Supta pada gustasana with wall
		12. Viparita karani (elevated)
		13. Savasana

Contd...

Appendix 1 : Contd...

Yoga type	Intervention summary	Components of intervention
		Home practice options (15–30 min) 1. Pranayama/meditation 2. Lower-back movements (i) Ankle rolls (ii) Lunges with knees at wall (iii) Lower back twists (iv) Savasana 3. Upper back movements (i) Wrist work sequence (ii) Arm and shoulder work with blocks (iii) Upper-back twists (iv) Savasana
Ashtanga yoga ^[27] Protocol developed by, yoga therapist, Faculty members of Osher Center with experience in yoga interventions for patients with breast cancer, and medical personnel from the UCSF breast surgery clinic Instructor trained in working with cancer patients Instructor led – 1 (in person) Instruction manual – 1 (Home based) Participants encouraged to modify poses as needed	Participants were encouraged to modify poses as needed. Practice included Surya Namaskar A & B series. Upper extremity weight bearing postures were modified suitably; inversions such as head stand, shoulder stand were avoided.	Surya Namaskar A and B sequences All asanas paired with breathing patterns of inhaling and exhaling with each sequential pose Standing erect: Samasthiti, Urdhva Hastasana (lifting arms above head); Uttanasana (forward fold); Ardha Uttanasana (head and chest lift with flat spine); slowly stepping back into Chatturanga Dandasana (plank pose) with bent knees for modification; Urdhva Mukha Svanasana (upward facing dog with slight backbend); and Adho Mukha Svanasana (downward dog). B. All the Surya Namaskar A asanas + Virabhadrasana I (bent knee lunge with arms above head) Limitations: UE weight-bearing poses (i.e., downward-facing dog/ Adho Mukha Svanasana was practiced judiciously and modified as needed; head and handstands were not done, nor were shoulder inversions)
Satyananda yoga ^[28] Teacher led 1/week (90 min), home-based DVD assisted – Daily (45 min) Options for modifications	Practice consisted of breath awareness, inner silence, abdominal, thoracic and clavicular breathing, movements for neck, shoulder, arms in seated, standing, lying postures, relaxation and discussion of yoga themes. Pranayama consisted of alternate nostril breathing, visualisation focus on lamps system and candle gazing meditation	Settling and breathing 10 min (DVD 10 min) Settling with awareness, mindfulness (inner silence) Abdominal, thoracic, clavicular breath Full yoga breath Postures 35 min (DVD 25 min) 1a Neck turns (Greeva Sanchalana) 1b Add outward rotation of opposite arm (Utthanpadasana-variation) 2 Knee hugs-leg lock pose (Supta Pawanmuktasana) 3 Shoulder circles (Shandha Chakra) 4 Bent arm opening, chest towards knees (Naukasana-variation combined with Namaskarasana-variation of arms) 5 Lying Archer (Akarna Dhanurasana-variation) 6 Lying rotation (Supta Udarakarshanasana-variation) 7 Arm/leg stretch (Supta Pawanmuktasana) 8 Sitting rowing (Nauka Sanchalanasana) 9 Standing archer (Akarna Dhanurasana) 10 Modified rope climbing (Rajju Karshanasana-variation) 11 Modified arm raise, knee bend (Tadasana-variation) 12 Modified side bend (Trikonasana-variation) 13 Standing rotation (Kati Chakrasana) 14 Standing Cat (Marjari-asana_variation) 15 Modified one legged prayer balance (Eka Pada Pranamasana) 16 Sitting neck turns (Greeva Sanchalana)

Contd...

Appendix 1 : Contd...

Yoga type	Intervention summary	Components of intervention
<p>Satyananda yoga^[29] Dr Maarten Immink in consultation with a yoga advisory group consisting of a lymphedema practitioner and yoga teachers with experience in yoga for women with breast cancer The female instructor was an accredited Satyananda Yoga® teacher with over 20 years' teaching experience</p>	<p>Practice involved asanas, breathing exercises (pranayamas), and meditation. A modified 40-min home program consisting of the same three main activities and based on practices learned in classes supported by an instruction manual and a CD audio recording of the relaxation exercise</p>	<p>Mindfulness, Pranayama, Meditation 10 min Settling with awareness and stillness (Kaya Sthairyam) Mindfulness practice (inner silence) (Antar Mouna level one weeks 1-4) Antar Mouna level one weeks 5–8 Alternate nostril breathing (Nadi Shodan) Visualisation one-pointed focus-lymph system (Dharana)* Meditation one-pointed focus candle (Tratak [3] weeks 7 and 8) Relaxation-meditation 20 minutes (DVD 10 min) Deep relaxation (Yoga Nidra)* Discussion yoga themes 10 min The 90-min weekly group classes involved three main activities: asanas, breathing exercises (pranayamas), and meditation. A modified 40-min home program consisting of the same three main activities and based on practices learned in classes was supported by an instruction manual describing and illustrating the practices and their alternatives, and a CD audio recording of the relaxation exercise.</p>